**Citation:**

Larsson SC, Rafter J, Holmberg L, Bergkvist L, Wolk A. Red meat consumption and risk of cancers of the proximal colon, distal colon and rectum: the Swedish Mammography Cohort. Int J Cancer. 2005 Feb 20;113(5):829-34.

**PubMed ID:** 15499619

**Study Design:**

Prospective cohort study

**Class:**

B - Click here for explanation of classification scheme.

**Research Design and Implementation Rating:**

POSITIVE: See Research Design and Implementation Criteria Checklist below.

**Research Purpose:**

The objective of this study was to prospectively examine whether the association of red consumption with cancer risk varies by subsite with the large bowel.

**Inclusion Criteria:**

The Swedish Mammography Cohort is a population-based prospective study including:

- women from Uppsala and Västmanland Counties (central Sweden)
- were 40-75 years of age at recruitment 1987-1990
- women responded to a mailed questionnaire at baseline that elicited information about diet, weight, height and education level.

**Exclusion Criteria:**

Women excluded:

- with erroneous National Registration Number
- with an extreme energy intake
- with a previously diagnosed cancer (except nonmelanoma skin cancer) at baseline.

**Description of Study Protocol:**

**Recruitment**

The women responded to a mailed questionnaire at baseline that elicited information about diet, weight, height and educational level.

**Design**

Prospective study analyzing data from the Swedish Mammography Cohort

**Statistical Analysis**

Each woman contributed follow-up from the date of her entry into the cohort to the date of a colon or rectal cancer diagnosis, date of death from any cause, of date of moving out from study period.

Women were categorized into 2 groups according to blood pudding consumption and into 3 groups according to poultry consumption. The incidence rates were computed by dividing the number of cases by person-years of follow-up in each category. Rate ratios (RRs) were calculated by dividing the incidence rate in a specific category of meat consumption by the rate in the lowest category. The proportional hazards assumptions were satisfied by using Cox proportional hazards regression to estimate RRs with 95% confidence intervals (CIs).

All multivariate analyses were adjusted for age, body mass index, educational levle and intakes of total energy, alcohol, saturated fat, calcium folate, fruits, vegetables and whole grain foods.Adjusted nutrient values for total energy intake used a regression analyses. For tests of linear trend, the median value of each category of intake analyzed as a continuous varialbe.

Differences in associations with cancers of the proximal colon, distal colon and rectus used a $x^2$ test. Analyses were performed using the SAS statistical software. All *p*-values were 2-sided.

**Data Collection Summary:**

**Timing of Measurements**

Baseline 1987-1990.

Follow-up in 1997.

**Dependent Variables**

- Ascertainment of colon and rectal cancer cases: identified by computerized linkages to the National Swedish Cancer Registry (from March 1987 through December 21, 2002) and the Regional Cancer Registry in the study area (from January 1, 2003 through June 30,2003).

**Independent Variables**

- Dietary Assessment: self-administered food-frequency questionnaire. Nutrient intake was calculated by multiplying the consumption frequency of each food item by the nutrient content per serving, using composition tales obtained from the Swedish National Food Administration Database.
    - red meat
    - processed meat
    - beaf and pork
    - fish
    - poultry

**Control Variables**

Age, body mass index, educational levle and intakes of total energy, alcohol, saturated fat, calcium folate, fruits, vegetables and whole grain foods; total energy intake

**Description of Actual Data Sample:**

**Initial N**: 66,651 women

**Attrition (final N):** 61,433 women

**Age**: 40-75 years

**Ethnicity**: Swedish

**Other relevant demographics**:

**Anthropometrics**

Baseline characteristics of 61,433 women according to red meat consumption

| Characterisitics | 1<br><50 g/dy | 2<br>50-69 g/dy | 3<br>70-93 g/dy | 5<br>≥94 g/dy |
|---|---|---|---|---|
| Participants (n) | 15,422 | 15,410 | 15,335 | 15,246 |
| Median red meat consumption (g/day) | 37 | 60 | 80 | 114 |
| Mean age (years) | 57.8 | 54.8 | 52.3 | 50.0 |
| Mean BMI | 24.5 | 24.7 | 24.8 | 24.9 |
| ≥12 years education (%) | 11.7 | 10.6 | 11.5 | 11.7 |
| Mean Intake energy (kcal/day) | 1,139 | 1,266 | 1,368 | 1,555 |

**Location**:

Central Sweden

**Summary of Results:**

**Key Findings**.

- Over a mean follow up- of 13.9 years, 234 proximal colon cancers, 155 distal colon cancers, and 230 rectal cancers were identified.
- A significant positive association between red meat consumption and risk of distal colon cancer (P for trend = 0.001) but not of cancers of the proximal colon (P for trend = 0.95) or

rectum (P for trend = 0.32) was observed.
- There is no association between fish consumption and risk of cancer at any site
- Poultry consumption had a modest inverse association with colorectal cancer risk.
- The multivariate rate ratio for women who consumed 94 or more g/day of red meat compared to those who consumed less than 50g/day was 2.22 (95% CI:1.34, 3.68) for distal colon, 1.03 (95% CI: 0.67,1.60) for proximal colon and 1.28 (95% CI: 0.87, 1.98) for rectal cancer.
- Multivariate RR of overall colorectal cancer according to red meat intake was 1.32 (95% CI: 1.03, 1.68; P for trend= 0.03) among extreme quartiles.
  No significant association between processed meat intake and colorectal cancer at any subsite was observed.
- Poultry consumption was weakly inversely related to risk of total colorectal cancer; multivariate RR of colorectal cancer for women consumed on average 1 serving of poultry per week was 0.75 (95% CI: 0.55, 1.02; P for trend = 0.04) compared to women who rarely or never consumed poultry.

**Author Conclusion:**

This prospective study provides evidence that high consumption of red meat may substantially increase the risk of distal colon cancer.

***Reviewer Comments:***

*The analyses did not adjust for family history of CRC or multiple comparisons.*

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***Research Design and Implementation Criteria Checklist: Primary Research***

| **Relevance Questions** | | |
|---|---|---|
| 1. | Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies) | Yes |
| 2. | Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about? | Yes |
| 3. | Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice? | Yes |
| 4. | Is the intervention or procedure feasible? (NA for some epidemiological studies) | N/A |

| **Validity Questions** | | |
|---|---|---|
| **1.** | **Was the research question clearly stated?** | Yes |
| 1.1. | Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified? | Yes |

| | | |
|---|---|---|
| 1.2. | Was (were) the outcome(s) [dependent variable(s)] clearly indicated? | Yes |
| 1.3. | Were the target population and setting specified? | Yes |
| **2.** | **Was the selection of study subjects/patients free from bias?** | Yes |
| 2.1. | Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study? | Yes |
| 2.2. | Were criteria applied equally to all study groups? | Yes |
| 2.3. | Were health, demographics, and other characteristics of subjects described? | Yes |
| 2.4. | Were the subjects/patients a representative sample of the relevant population? | Yes |
| **3.** | **Were study groups comparable?** | Yes |
| 3.1. | Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT) | N/A |
| 3.2. | Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline? | N/A |
| 3.3. | Were concurrent controls used? (Concurrent preferred over historical controls.) | N/A |
| 3.4. | If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis? | Yes |
| 3.5. | If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.) | N/A |
| 3.6. | If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")? | N/A |
| **4.** | **Was method of handling withdrawals described?** | Yes |
| 4.1. | Were follow-up methods described and the same for all groups? | Yes |
| 4.2. | Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.) | Yes |
| 4.3. | Were all enrolled subjects/patients (in the original sample) accounted for? | Yes |
| 4.4. | Were reasons for withdrawals similar across groups? | Yes |

| | | |
|---|---|---|
| 4.5. | If diagnostic test, was decision to perform reference test not dependent on results of test under study? | N/A |
| **5.** | **Was blinding used to prevent introduction of bias?** | N/A |
| 5.1. | In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate? | N/A |
| 5.2. | Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.) | N/A |
| 5.3. | In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded? | N/A |
| 5.4. | In case control study, was case definition explicit and case ascertainment not influenced by exposure status? | N/A |
| 5.5. | In diagnostic study, were test results blinded to patient history and other test results? | N/A |
| **6.** | **Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?** | Yes |
| 6.1. | In RCT or other intervention trial, were protocols described for all regimens studied? | N/A |
| 6.2. | In observational study, were interventions, study settings, and clinicians/provider described? | N/A |
| 6.3. | Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect? | Yes |
| 6.4. | Was the amount of exposure and, if relevant, subject/patient compliance measured? | Yes |
| 6.5. | Were co-interventions (e.g., ancillary treatments, other therapies) described? | Yes |
| 6.6. | Were extra or unplanned treatments described? | N/A |
| 6.7. | Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups? | Yes |
| 6.8. | In diagnostic study, were details of test administration and replication sufficient? | N/A |
| **7.** | **Were outcomes clearly defined and the measurements valid and reliable?** | Yes |
| 7.1. | Were primary and secondary endpoints described and relevant to the question? | Yes |
| 7.2. | Were nutrition measures appropriate to question and outcomes of concern? | Yes |
| 7.3. | Was the period of follow-up long enough for important outcome(s) to occur? | Yes |
| 7.4. | Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures? | Yes |

| | | |
|---|---|---|
| 7.5. | Was the measurement of effect at an appropriate level of precision? | Yes |
| 7.6. | Were other factors accounted for (measured) that could affect outcomes? | Yes |
| 7.7. | Were the measurements conducted consistently across groups? | Yes |
| **8.** | **Was the statistical analysis appropriate for the study design and type of outcome indicators?** | Yes |
| 8.1. | Were statistical analyses adequately described and the results reported appropriately? | Yes |
| 8.2. | Were correct statistical tests used and assumptions of test not violated? | Yes |
| 8.3. | Were statistics reported with levels of significance and/or confidence intervals? | Yes |
| 8.4. | Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)? | N/A |
| 8.5. | Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)? | Yes |
| 8.6. | Was clinical significance as well as statistical significance reported? | Yes |
| 8.7. | If negative findings, was a power calculation reported to address type 2 error? | N/A |
| **9.** | **Are conclusions supported by results with biases and limitations taken into consideration?** | Yes |
| 9.1. | Is there a discussion of findings? | Yes |
| 9.2. | Are biases and study limitations identified and discussed? | Yes |
| **10.** | **Is bias due to study's funding or sponsorship unlikely?** | Yes |
| 10.1. | Were sources of funding and investigators' affiliations described? | Yes |
| 10.2. | Was the study free from apparent conflict of interest? | Yes |